CONE SHAPED POLYGON ROOF STRUCTURE

BACKGROUND OF THE INVENTION

This invention relates to a roof structure for a building including a vertically extending essentially non-load supporting central column which is spaced above supporting structure for the roof structure, and at least three trusses joined on their inner ends to the column and extending radially outwardly and downwardly to the roof supporting structure. Each of the trusses is rotationally displaced in a horizontal plane from adjacent ones of the trusses to form at least three triangularly shaped roof segments of a cone shaped polygon configuration.

Broadly speaking, cone shaped polygon roof structures are known in the prior art. See, for example, the gazebo roof disclosed in U.S. Pat. No. 4,739,594 granted to J.D. Langford et al. on April 26, 1988 and the roof structure taught in U.S. Pat. No. 4,332,116 granted to H.A. Buchanan on June 1, 1982. The gazebo roof structure of Langford et al. is made of eight triangularly shaped segments, each segment having two wood side beams of one inch by four inch board joined together at an apex and a series of radially spaced apart cross members. The side beams of the eight segments have inner ends which are mounted in U-shaped brackets secured around a central hub. The roof structure of Buchanan contains fifteen triangularly shaped segments, each segment having two side beams

or roof components meeting at an apex, and a series of radially spaced apart cross members. The roof components are supported on their radially inner ends on a support plate which is welded to an upper end portion of a weight supporting central column which extends from floor to ceiling in the reference structure.

None of the prior art roof structures are formed using multi-element truss members. While the gazebo roof structure of Langford et al. contains a non load supporting central hub, the fact that rafters or wood side beams are used severely limits the roof span and, consequently, limits the amount of floor space obtainable under roof. On the other hand, the much greater span of roof structure envisioned by Buchanan requires that his rafters must be supported not only on their radially outer ends by posts or columns, but also by a load supporting floor to ceiling central column in the center of the span.

In the gazebo of Langford et al., adjacent ones of the reference roof supporting posts must be rigidly tied together by cross members to prevent the roof structure from sagging and , thereby, tilt the posts radially outwardly. This would have the effect of spreading the posts apart at their upper ends, therefore permitting the roof to sag and, ultimately, the building to collapse. The cross members thus prevent the upper ends of

the posts from spreading apart and therefore prevent the roof from sagging.

It would be desirable to have a cone shaped polygon roof structure of the size envisioned by Buchanan which can be entirely supported on and around an outer perimeter portion of the structure without need for a span interrupting central weight supporting column and without need for rigidly connecting upper ends of adjacent roof supporting posts together to prevent roof sag.

By means of the present invention, these and other problems encountered in such prior art roof structures are substantially eliminated.

BRIEF SUMMARY OF THE INVENTION

It is an object of my invention to provide a novel truss reinforced cone shaped polygon roof structure.

It is a further object of my invention to provide such a roof structure wherein a plurality of trusses are joined on corresponding ends to an essentially non-weight supporting central column which is elevated above support structure for peripheral end portions of the trusses so that the roof structure forms a free span over any selected diameter of the roof structure.

Briefly, in accordance with my invention, there is provided a roof structure for a building including an essentially non-load supporting, vertically extending central column having a lower end spaced above a supporting structure of the roof structure. The roof structure further includes a plurality of at least three elongated and vertically inclined, multi-element trusses fixedly joined on innermost ends thereof to the central column. The trusses are rotationally displaced from one another in a horizontal plane. Each of the trusses extend radially outwardly and downwardly from the central column to an outer end portion thereof for mounting on the supporting structure at a level spaced below a lower end of the column. The plurality of trusses thereby defines a roof structure in the form of a cone shaped polygon.

These and other objects, features and advantages of the present invention will become apparent to those skilled in the art from the following detailed description and attached drawings upon which, by way of example, only a preferred embodiment and certain modifications of the invention are illustrated.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a perspective view of a corral having truss supported cone shaped roof structure, thus illustrating a preferred embodiment of my invention.

FIG. 2 shows a top plan view of the roof structure of FIG. 1.

FIG. 3 shows a plan view of four strips of corrugated roofing used on the roof structure of FIGS. 1 –2, thus illustrating how the strips are cut to form two segments of the roofing of the subject structure.

FIG. 4 shows an end elevation view of a portion of the roofing strips of FIG. 3 showing overlapping edges of two adjacent ones of the strips and illustrating the corrugations therein.

FIG. 5 shows a cross-sectional elevation view of the roof structure of FIGS. 1 – 2 as viewed along cross-section lines 5 – 5 of FIG. 2.

FIG. 6 shows a perspective view of a fragment of the roof structure of FIGS. 1 – 2 and 5 as viewed along view-lines 6 –6 of the latter mentioned figure.

FIG. 7 shows an enlarged detail view of a portion of the roof structure of FIGS. 1 – 2 and 5, the same as viewed in FIG. 5.

FIG 8 shows a top plan view of the roof structure portion shown in FIG. 7 with certain parts replaced and with corrugated metal roofing removed.

FIG. 9 shows an enlarged detail view of a central portion of the roof structure of FIGS. 1–2 and 5, the same as viewed in the latter mentioned figure.

FIG. 10 shows an enlarged detail view of a fragment of the central portion shown in FIGS. 1 – 2 and 9, the same as viewed in FIG. 2.

FIG. 11 shows a cross-sectional view of the central portion of FIG. 9 as viewed along cross section lines 11 – 11 of the latter mentioned figure and with certain parts replaced.

FIG. 12 shows a partially cross-sectioned elevation view of a portion of roof structure similar to FIG. 7, except modified to replace the corrugated roofing with a tarpaulin.

FIG. 13 shows a top plan view of the roof structure portion of FIG. 12 with the tarpaulin removed.

FIG. 14 shows a top plan view of a central portion of the roof structure of FIGS. 12 – 13.

FIG. 15 shows a partially cross-sectioned side elevation view of the central portion of FIG. 14.

FIG. 16 shows a side elevation view of a portion of one of the trusses in the roof structure of FIGS. 12 – 15.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawing figures and, in particular, to FIGS. 1–2, there is shown, in a preferred embodiment of my invention, a building structure, generally designated 20, which includes a novel roof structure, generally designated 22, in the form of a cone shaped polygon. While it can be readily adapted for many different uses, the structure 20 of the present example is shown in the form of a corral for confining animals such as horses or cattle. For this reason, the perimeter of the structure 20 is shown as being enclosed by a board fence of conventional type having a series of adjoining panels 24 and a standard latchable entrance gate 26. It will be appreciated that the building structure 20 could include any number of different types of siding of well known type, as desired, depending, at least in some instances, on the purpose for which the structure is to be used. The roof structure 22 of the present example contains twelve triangularly shaped segments 28, as viewed in plan (FIG. 2), and is fully supported on twelve posts 30 (FIGS. 1, 5 and 7) spaced on and around a perimeter of the roof structure. Each of the posts 30 are located at an intersection between different adjacent pairs of the segments 28. The posts 30 are preferably constructed of wood and each post is preferably square in cross-section with a cross-sectional dimension of 6" by 6" and has a length

of 13 ½ ft, a lower 3 ½ ft of which is preferably below grade in 2 cubic feet of concrete footing.

Referring now to FIGS. 1 – 11, details of the roof structure 22 are shown including a conventional corrugated sheet metal roofing 32 and a series of twelve steel trusses 34, each of the trusses having an upper beam 34a, preferably inclined at 22 degrees with the horizontal, and a lower beam 34b, preferably inclined at a 16 degree angle with the horizontal. Each of the trusses 34 are rotationally displaced from adjacent ones of said trusses by an equal angle of displacement as measured in a horizontal plane and contain a series of vertically extending and radially spaced apart steel spacer members 36, forming a series of truss sections between adjacent ones of the spacer members. In the present example there are four truss sections, each being 5" – 6" in horizontal length, and a like series of steel inclined or diagonally extending reinforcing members 38, a different one of which is disposed in each of the truss sections. The beams 34a and 34b and spacer members 36 can be welded together at their intersections and may be constructed of standard 1 ½" x 1 ½" hollow box tubing, preferably being at least 1/8" in thickness. The reinforcing members 38 can also be welded on their ends at intersections between the beams 34a or 34b, as shown, and may be constructed of 1" x 1" standard box tubing of at least 1/8" thickness. A radially outer and lower end of each

of the inclined members is welded at an intersection between the lower beam 34b and a radially outer one of the spacer members 36 forming an outer end of a corresponding one of the truss section. Similarly, an upper radially inner end of each of the inclined members 38 is welded to an intersection between the upper beam 34a and a radially inner one of the spacer members 36 which forms an inner end of a corresponding one of the truss section.

The outermost vertical spacer 36 of each of the trusses 34 extends below a corresponding one of the lower beams 34b along an outer facing side of a different one of each of the posts 30, as shown in FIGS. 5 and 7, so that each of the outermost spacers can be joined to an upper end portion of a corresponding one of the posts by conventional fasteners such as nuts and bolts 40. The upper beam 34a of each of the trusses 34 is welded to an upper end of a different one of the outermost vertical spacers 36 and extends outwardly beyond the outermost spacer into an end portion of a larger piece 42 of steel box tubing (See FIGS. 7 –8), preferably about 6 inches in length and 2" x 2" in cross-section. Each upper beam 34a, thus inserted into a corresponding box tubing piece 42, is joined to the latter by a nut and bolt 44.

Referring now specifically to FIGS. 7 –8, the outermost end of each of the twelve box tubing pieces 42 is welded, as at 43 (FIG. 7), to an angular

intersection between a pair of flat, rectangularly shaped steel mounting plates 45a and 45b. In the present example, wherein the roof structure 22 contains twelve segments 28, the interior angle between the intersecting plates 45a and 45b should be 150 degrees. The plates 45a and 45b are, in turn, fastened to opposing end portions of abutting 2" x 6" wood board peripheral trim members 47a and 47b, respectively (See also 47 in FIG. 1), which trim members contain intersecting ends which are cut on a 105 degree angle of taper relative to their lengths. The trim members 47a and 47b can be fastened to the plates 45a and 45b, respectively, with a series of wood screws 49.

Referring now specifically to FIGS. 2, 5, 7 and 8–9, each of the segments 28 contain a series of radially spaced apart 2" x 4" wood board upper cross braces 49 of differing lengths which span between and abut adjacent pairs of the upper beams 34a of the trusses 34. The cross braces 49 are held at each end in conventional saddle hangers 51 which are fitted over each of the upper beams 34a and are welded or otherwise suitably fastened thereto, as, for example, at welds 53 in FIG. 8. The cross braces 49 can then be secured to the saddle hangers 51 by means of suitable wood fasteners such as wood screws or nails 55.

The innermost end of each of the trusses 34 contains a vertical box tube spacer 46 which is joined to a corresponding innermost end of a

corresponding one of the upper beams 34a, lower beams 34b and incline members 38 by welds as shown in FIG. 9 at 48 and 50. The spacers 46 are, in turn, fastened to and around a hollow cylindrically shaped steel central column 52 (See FIGS. 9 and 11) by means of three vertically spaced apart series of nuts and bolts 54, 56 and 58 (FIG. 9 only). In the present example, the column may be a 6" diameter steel pipe, 4 ½' long. In any event, the column 52 need only be long enough to permit joinder of the spacers 48 thereto so that the innermost ends of corresponding ones of the beams 34a and 34b and inclined members 38 can be welded to such spacers. Thus, the need for a floor to ceiling central column is eliminated, allowing the roof structure 22 to be a free overhead span across any diameter thereof. A disc shaped steel plate 60 (FIG. 9) is placed on an upper end of the column 52.

Over the plate 60 and innermost ends of the roofing 32 of the segments 28 is placed a cone shaped sheet metal cap 62 (See FIGS. 9–10), preferably about 2' in diameter, to prevent rain and melt water from leaking between the roofing 32 along the outside surface of the column 52 into the corral below the roof structure 22. The cap 62 may be formed by first cutting a disc shaped piece out of a flat sheet metal, then by cutting along a radius of the piece followed by lapping one of the resulting edge portions 64 over an opposing edge portion 65, as shown in FIG. 10, to form

the desired cone shape, as shown in FIG. 9. An elongated central vertical pin 66 with exterior threading on a lower end portion thereof may be inserted through central openings in the cap 62 and plate 60. To stabilize the pin 66, a second plate 68 is disposed within the column 52, so as to be spaced below the plate 60 and is held in place by a nut 70 which is located thereunder around a lower threaded end portion of the pin 66 as shown in FIG. 9.

Referring now to FIGS, 5 –6, a pair of radially spaced apart lower cross braces 72, preferably made of angle iron, can be placed between adjacent pairs of the lower beams 34b to stabilize them. To this end, a flat, rectangular steel plate 74 is welded to an upper surface of the box tubing forming the lower beam 34b and, then, overhanging portions of the plate are secured to end portions of the lower cross braces 72 with suitable fasteners, such as a nut and bolt combination 76 as shown in FIG. 6. The resulting trusses 34 of the present example are each 22 feet in horizontal length between an outer face of any one of the posts 30 and a corresponding one of the innermost spacer members 52. The diameter of the interior of the structure 20 of the present example is approximately 43' – 9" between opposing interior faces of opposing ones of the posts 30. The interior height of the roof structure 22 varies from about 10 feet, as measured vertically along any one of the peripheral posts 30, up to about

15' –6" at the center of the roof structure between grade, taken at a base of any one of the posts 30, and a lower end of the column 52.

Referring now to FIGS. 2 –4, to form the triangular segments 28 of the roofing 32, four strips 78 of corrugated roofing sheet having lengths of 24 feet and widths of 38 inches can be laid side-by-side so that opposing sides of adjacent pairs of the strips have a overlapping corrugations 80 along their long dimensions (FIG. 4). The arrangement thus formed is shown in FIG. 3. To form a pair of triangularly shaped pieces of the roofing 32 to cover two of the segments 28, the sheets 78 of FIG. 3 are cut along dashed cut lines 82 as shown The resulting central isosceles triangle, cut along the lines 82 in FIG. 3, forms one of the roofing pieces for covering one of the segments 28. The remaining two right triangular pieces on opposite sides of the central triangle can be joined back-to-back along their sides 84 and, similarly, overlapping two inches to form the other roofing piece for covering a second one of the segments 28. Each of the resulting segments 28 is laid between a different adjacent pair of trusses 34. A standard ridge cap 85 overlaps adjoining segments 28 and is fastened to the wood cross hexes 49.

Referring now to FIGS. 12 –16, there is shown, an alternative roof covering comprising a flexible, waterproof, tarpaulin 86 which can be used to cover the roof structure 22 of the previous example, by making a few

modifications, in place of corrugated sheet metal roofing 32. One of the modifications is in the use of angle iron upper cross-braces 88 (See FIG. 16) between adjacent pairs of the upper truss beams 34a in place of the wood board cross braces 49 and saddle hangers 51 of the previous example. The upper cross braces 88 are bolted on end portions thereof to rectangular plates 90 welded to an upper surface of the upper beams 34a in the same manner as the cross braces 72 of the lower beams 34b are fastened to the plates 74, as shown in FIGS. 5 –6 and 16. Only a pair of the upper cross braces 88 need be used to adequately stabilize the upper beams 34a when using the tarpaulin 86, one of which upper cross braces is located in each of the two central sections of each of the trusses 34, similar to the placement of the two lower cross braces 72 as shown in FIG. 5.

The only other modifications to the roof structure of the previous example needed for the use of the tarpaulin 86 is that shown in FIGS. 12 – 13 wherein the mounting plates 45a and 45b and the wood trim members 47a and 47b of the previous example are replaced by elongate box tubing peripheral members 92 such as shown in FIG. 12. The peripheral members 92 are preferably 2" by 2" box tubing to match the box tubing piece 42 to which they are welded at their abutting ends as at 94 in FIGS. 12–13.

The circular tarpaulin 86 should be of sufficiently large diameter to permit outer edge portions to be wrapped around the peripheral members 92 and lapped back under the same as shown in FIG. 12 at 96. Outer edge portions of the tarpaulin 86 contain a series of eyelets 98, preferably about every 16 inches around the entire perimeter thereof. A length of cord 100 can be strung through each of the eyelets 98. Each of the cords 100 is then strung between each of the eyelets 98 and a peripherally extending steel cable 102 which is strung around an outer edge portion and underneath each of the upper beams 34a through a suitable eye screw or eyelet 104 fastened or welded to each of the upper beams 34a (See FIG. 12). An eyelet 106 is placed at the center of the tarpaulin 86 through which the pin 66 can be extended as shown in FIGS. 14 –15. By using the tarpaulin 86 of the present example, the cone shaped cap 62 of the previous example will not be needed and can be omitted if desired, as indicated by its absence in FIG. 15.

In conclusion, it will be apparent that the roof structure of my invention may contain as few as three triangular segments, as viewed in the plan. That is to say, these may be as few as three trusses 34 rotationally displaced from adjacent ones of the trusses, preferably by 120 degrees as measured in a horizontal plane, or as many more than three as considered practical, including, if desired, more than the twelve trusses and segments

as contained in the roof structure 22 of the present example. In any case, it is preferable that horizontal angle of displacement of each of the trusses from adjacent ones of the trusses be equal around the entire roof structure.

Although the present invention has been shown and described with respect to specific details of a certain preferred embodiment thereof, it is not intended that such details limit the scope and coverage of this patent other than as expressly set forth in the following claims, making allowance for reasonable equivalents thereof.